CLIMATE-RISK-ADJUSTED INVESTMENT (*CRAI*) MODEL – A FINANCIAL DECISION TOOL

DR V GAJAPATHY
Associate Professor, School of Management, Presidency University, Bengaluru-560 064

ABSTRACT

The financial commitment by an entrepreneur is carrying a far-fetching effect on the investment landscape of the firm. The financial decision making which deprives of the climate change with futuristic outlook shall lead to risk assumption. For instance, the countries have to pay carbon-tax whose carbon emission is aggravating climatic and environmental adversities. This Paper is addressing the challenges of factoring the climate-elements in onto the investments. In other words, the investor is embedding the risk which is posed by climate changes on the existing investment model. Integrating the price on climate change with investment portfolio requires inputs such as assessment of risk, quantum of risk, and arriving at climate-risk-adjusted investment model. For the purpose of this, the Paper confines the risk factor which affect investment decision, to the marginal cost alone due to climate-change. The cost of climate change will impact the profit sheet of the companies and consequently the value and prospects. This conceptual Paper advocates a model in conclusion which may be based for investment decisions for individuals and firms, and further taken progressively for research purposes.

KEY TERMS: Climate change, climate-risk-adjusted investment, pricing climate risk, investment decision.

1. INTRODUCTION

The investment investigator assumes the importance when investment has a determining influence on the economy. In plain words, 'producing estimates of expected returns' [1] is highly challenging to any investor. This task becomes very strenuous when the mandate is to factor the climate-risk in investment model. Because, considering climate-risk returns latently and carries no immediate benefit but harm, if it is not considered instantly. Behavioural modifications in the investor may have fruitful effect but with remote chance. Forecasting the investment effect after considering the climate-risk is entitling the experiment of pricing the climate-change-risk. This often demobilizes the investment

investigators and renders a sluggish advancement.

1.1 OBJECTIVES

To design an investment model incorporating climate-risk as a single factor. This objective provide a solution to investors to protect their resources personally and socially from historic risk associated with climate-risk and climate-change-risk.

II REVIEW OF LITERATURE

Economic theories and concepts are needed to understand the role of markets in addressing pollution. It is to analyze environmental problems from the perspective of market failure, explore several solutions to environmental problems, and provide numerical examples to illustrate the advantages of some of these solutions. Although most people would agree that market-based solutions are superior to command-and-control measures, debate continues regarding the desirability of market solutions versus taxes and subsidies [2] (P.11) Organisations have started to mobilise the ability to adjust investment patterns, and portfolio composition which will reflect the evolving nature of possible demand and regulatory changes (*emphasis added*) [3]. But the stakeholders are not excelling thrust on climate-risk and its attendant challenges in the economic arena. The resources are depleting faster and waning down in quality to bring out new level of production. 'A significant amount of the spending will be used to enhance production from existing levels as they naturally decline with age, rather than in developing new resources' [3] (p.6). For example, carbon tax or sin tax are meant for the society's growth and development rather than individuals' specific gains. 'As long as climate change mitigation actions are pending, the low-carbon index obtains the same return as the benchmark index; but once carbon dioxide emissions are priced, or expected to be priced, the low-carbon index should start to outperform the benchmark'[3]. The Company uses mature processes to assess and mitigate risk and support decision making, including mitigation of climate change risks [3] (p.8). However, pricing climate-risk or climate change risk is making an inroad for price quarrels. Since 2008, our internal carbon price has been considered in the economic evaluations supporting major capital project appropriations [3] (p.10).

There are some research which revolves around expected future carbon footprint to establish the charge to the extent of carbon footpint. 'Ideally, the green filter should take

into account expected future carbon footprint reductions resulting from current investments in energy efficiency and reduced reliance on fossil fuels. Similarly, the green filter should penalize companies that invest heavily in exploration with the goal of increasing their proven reserves, which raises the risk of stranded assets for such companies. This "threat" would provide an immediate incentive to any company with an exceptionally high carbon footprint to make investments to reduce it and would boost the financial returns of the decarbonized index relative to the benchmark [2] P.19.

From a purely risk management view, when opportunities exist to reduce the dangers of global warming that are cheaper than the catastrophic losses global warming may create, any and all options must be considered to combat it [4] (p.35).

III RESEARCH METHODS

This research has taken a mathematical model building with single industry along with the concept of ***economies of scale***. As this is a model-building research, the existing investment model has been taken up to adjust the climate risk against returns out of investment. The climate-risk is represented as third term in the investment model. This term is notated as $\frac{e_i}{f}$. The numerator explains the climate-risk exposure as ratio of investment done by the entrepreneur which otherwise speaks about the magnitude of risk due to climate. The denominator f denotes the frequency part of the risk. If a particular risk, for example, flood, occurs once in ten years means, the f is equal to ten. The return on investment carries two components as (a) constant, α, independent of returns of industry which is progressing on using economies of scale and (b) the beta, β, which depends on the economies of scale gained by the industry. The benefits of economies of scale passed by the industry to its member firm is represented by this beta.

This CRAI Model is holding the following assumptions:

A the industry is enjoying economies of scale and it contributes the member firm also

B the climate risk is independent of economies of scale.

C the net effect because of inflow and outflow due climate-risk is zero. Hence, the mean value of $\frac{e_i}{f}$ is equal to zero.

IV DISCUSSION AND ANALYSIS

The predominant return on investment model is [5],

$$R_i = \alpha_i + \beta_i R_I$$

However, the climate-risk is adjusted against the investment made, as

$$R_i = \alpha_i + \beta_i R_I - \frac{e_i}{f}$$

(1)

Where

α_i is the component of investment *i*'s return that is independent of the industry's performance – a random variable

R_I is the rate of return on the industry benchmark – a random variable

β_i is a constant that measures the expected change in R_i given a change in R_I .

$\frac{e_i}{f}$ is climate-risk factor. The numerator e_i is explaining the portion of investment exposed to climate-risk whereas the f stands for frequency of climate-risk (in number of years)

Here, it is noteworthy that the $\frac{e_i}{f}$ term is uncorrelated with R_I which signifies as follows:

$$cov\ (e_i, R_I = E[(e_i - 0)(R_i - R_I)] = 0$$

(2)

By construction

$$\text{Mean of } \frac{e_i}{f} = E(\frac{e_i}{f}) = 0$$

This is because, the inflow and outflow due to climate in the climate-risk adjusted model is the same. This constraint stands affront in this investment model. In the meantime the return on investment is reduced to the extent that the climate-risk is eating out.

By assumption

Industry unrelated to specific/unique return for all investments $i = 1, \ldots N$

$$E(\frac{e_i}{f})(R_i - R_I)] = 0$$

(3)

Investments related only through common response to industry (for all pairs of investments.

$E[(\frac{e_i}{f})\ (\frac{e_j}{f})] = 0$

It is derived that the Expected Return, Standard Deviation and Covariance when the single-industry model is employed to evaluate the combined movement of investments. The following are the results:

1 The mean return, $R_i = \alpha_i + \beta_i R_I$;

2 The variance of investment's return, $\sigma_i^2 = \beta_i^2 \sigma_I^2 + \sigma_{\frac{e_i}{f}}^2$

3 The Covariance of returns between Investments i and j : $\sigma_{ij} = \beta_i \beta_j \sigma_I^2$.

V CONCLUSION

1 The expected return has two components as a unique measure (α) and market related measure as $\beta_i R_I$.

2 Investment variance also has two measures.

3 The Covariance contrarily relies only on Industry risk (economies of scale).

4 The investors in the firm shall expect only a lower return due climate-risk which may impact its cost sheet either immediately or at the end of the risk tenure.

VI BIBLIOGRAPHY

[1] Alexander, J. Gordon and G. Benston B, "More on Beta as a Random Coefficient," Journal of Financial and Quantitative Analysis, vol. XVII, no. 1, pp. 27-36, March 1982.

[2] R. L. Sandor, N. J. Clark, M. Kanakasabai and R. L. Marques, "Environmental Markets: A New Asset Class," Research Foundation of CFA Institute, New York, 2014.

[3] CFA INSTITUTE, Ed.Financial Analysts Journal, vol. 72, no. 3, 2016.

[4] R. A. Posner, Catastrophe: Risk and Response, Oxford: Oxford University Press, 2004 , p. 35.

[5] Alexander, G. J and L. N. Chervany, "On the Estimation and Stability of Beta," Journal of Financial and Quantitative Analysis, vol. XV, no. 1, pp. 123-138, March 1980.

[6] E. J. Elton, M. J. Gruber, S. J. Brown and W. N. Goetzman, Moden Portfolio Theory and Investment Analysis, New Delhi: Wiley, 2010.

[7] John S. Watson, "Managing Climate Change Risks--A Perspective for Investors," Chevron, 2011.